Aviation Rulemaking Advisory Committee (ARAC)
Transport Airplane and Engine (TAE) Issues Area

Meeting Minutes

Date: September 23, 2009
Time: 9:00AM
Location: Boeing
Arlington, VA

Call to Order /Administrative Reporting

Mr. Craig Bolt (TAE Assistant Chair) called the meeting to order at 9:00AM.

Mr. Mike Kaszycki (TAE Assistant Executive Director) read the Federal Advisory Committee Act (FACA) statement.

Mr. Bolt reviewed the agenda.

Item	March 11, 2009 TAEIG Meeting Action Items	Status
1.	FAA (James Wilborn) to clarify why policy statement used instead of revising Advisory Material.	CLOSED
2.	Oliver Rusch to provide TCCA plans for addressing equivalent Part 26 requirements /retroactive requirements to existing fleets.	CLOSED
3.	Oliver Rusch to discover more details on who can attend TCCA's delegates conference.	CLOSED
4.	Doug Kihm to send letter by June 19 to C. Bolt to attach to submittal of IPHWG Phase 4 reports with Boeing comments on the documents.	CLOSED
5.	R. Varanasi to provide FAA background on concerns relating to potential differences between FAA Ageing Aircraft plans and those of EASA.	CLOSED

FAA Report
Mr. James Wilborn presented this report. (See Handout #1.)

Mr. Keith Barnett asked whether there is training developed for Low Speed Awareness. Mr. Wilborn replied that he has not heard anything from a regulatory perspective from AFS specifically about training for Low Speed Awareness. Mr. Kaszycki stated that more than one working group would be tasked with this issue. One potential method may be to have Avionics HWG as the lead, with other working group on hand for support.

Mr. Kaszycki and Mr. Bolt discussed the logistics of how the FAA would harmonize projects with EASA. The FAA also currently has list of upcoming rulemakings and priorities (Validation Items List), and has been trying to have EASA publish a similar list. The FAA updates this list on a yearly basis. However, EASA has not yet published such a list.

Mr. Kaszycki responded to a question from Mr. Peters about the status of the Arsenal AC. Mr. Wilborn responded this is an § 25.1309 AC, which is still an ARAC tasking. The FAA is waiting on the outcome of the current ASAHWG tasking to determine how to go forward with revision of § 25.1309 and the accompanying guidance material. If the FAA does not proceed with changes to the rule based on the ASAHWG recommendations, we would proceed with amending § 25.1309 harmonize with the current CS 25.1309.

Mr. Kihm asked: Low Fuel Alerting is identified as a harmonization item—does EASA see it as an ETOPS issue or as more than ETOPS? Mr. Kaszycki responded that the FAA has looked on this for a long time as a possible part 25 requirement. Based on past events and current evaluation, the FAA does not consider Low Fuel Alerting to be just an ETOPS issue,

Mr. Wilborn continued his presentation on the harmonization effort. He stated that the harmonization meeting in July, 2009, in Ottawa, was the first harmonization meeting where EASA, the FAA, and Transport Canada began to substantively discuss the harmonization coordination process.

Mr. Barnett asked what is the "do by other means" list. Mr. Wilborn responded, this is a list of items where FAA and EASA will try to achieve the same level of safety without doing rulemaking changes. Not everything needs to be achieved through rulemaking—which is a fairly slow process. There are other methods such as special conditions, etc. Mr. Kaszycki stated that when the harmonization management team that was working with JAA came to a close, there were more projects than the rulemaking process could handle. The FAA and EASA then decided that harmonization for harmonization's sake is no longer viable, and re-sorted the list of projects into rulemaking items and "do by other means" items. These have been left on the backburner while parties focused on the rulemaking items, but are now coming into focus again. The FAA would like to promulgate them into a rule over the next several years.

Mr. Wilborn stated that, some of these listed rulemakings do not have a working method attached yet. This list is always a work in progress.

Mr. Kihm asked about the two stars besides a project on the FAA rulemaking project list. Mr. Wilborn stated that project is waiting for more resources, which might be what the stars are for.

Mr. Kihm asked where could industry obtain status on the Part 21 projects. Mr. Kaszycki replied he is not aware of any issues group that are reporting status on these projects, but gave Mr. Kihm the name of AIR's rulemaking coordinator, Sol Maroof.

<u>Airplane-level Safety Analysis WG Report</u>
Edward Wineman and Roger Knepper presented this report. (See Handout #2.)

Task #4 Status (See Handout #3)
Mr. Knepper presented Task 4 status. He stated that the ASAWG will present recommendations for Aging & Wear, MMEL, and Flight & Diversion Time. However, the ASAWG cannot agree on the Latent/Active issue, and would not be making any recommendations on this issue.

Ms. Knife asked about the Aging & Wear issue, specifically about increasing consistent application and improve safety. She stated she believe the ASAWG has previously agreed that it would not increase consistency but would not improve safety. Mr. Knepper responded that different manufacturer treat ageing aircraft differently, but the main issue remains harmonization.

Mr. Kaszycki stated that, since all the regulatory authorities on the ASAWG cannot agree on Aging & Wear, the probability of the FAA adopting these recommendations are slim. When there are dissenting opinions in a report, its value becomes more about understanding industry's positions and less about adopting its recommendations.

Mr. Barnett asked a question about who in the working group were dissenting over this sentence in the draft Task 4 Report, "*[a]bove shall include common mode ageing and wear…*" Mr. Linh Le (?) replied that the authorities recommended deleting this sentence, but industry would like to keep it.

Mr. Kaszycki stated that the FAA is looking for a summary of the dissenting opinions and why the ASAWG did not adopt them, rather than merely polling ASAWG members and setting forth all the dissenting opinions. Such a summary would be extremely helpful later on towards revealing how some dissents are not black-and-white disagreements, and may be resolvable by some other methods than currently supplied.

Mr. Barnett made a remark about Boeing's dissenting opinion of MMEL. Mr. Wineman replied that Boeing knew the intent of the criteria was to reduce the scope of needed work for quantitative calculations, and realized that the recommendation did not go far enough towards reducing that work. Mr. Le stated that the dissent was over one sentence: "*[i]f the configuration used more than two Failure Aways, then you do not need to do an H/L(means Hardware Level) analysis.*" They then discussed all dissenting issues in technical detail.

Mr. Kihm stated, with some additional effort on the working group's part, the dissenting opinion about ETOPS may still be resolved in the final report. TAEIG members agreed.

Mr. Knepper continued to present the Latent issue (see Handout #3).

The Latent subgroup agreed on the following "golden rules:"

- All other regs and guidance would be revised to point to 25.1309 in regards to specific risk of latent failures
- 25.1309(b)(4) to prescribe quantitative limit latency and residual risk
- Revision of Arsenal AC to include qualitative guidance for limit latency best design practice

In a Sept 16 polling, 14 of 17 organizations participated. 11 of 14 voted to accept the final latent change recommendation in accordance with the task force outcome.

Ms. Knife stated that GE's dissent on the Latent issue poll is because the proposed set of "golden rules" make it extremely difficult to certify dual-engine aircraft in the future. Mr. Paul Mingler stated that the "golden rules" contain specific numbers; GE was most concerned about the inflexibility of the quantitative requirement—that GE can either comply with these numbers, or it cannot. Mr. Barnett stated that Bombardier also has this concern about the actual numbers.

Mr. Wineman stated that he is still not understanding this concern, because a number of companies had created fault trees and other evaluations based on the numbers provided in this report, and did not run into any problems.

Ms. Knife stated that engines, being mechanical systems, have a large number of potential latent failures in their physical design that could occur. If there are no way to monitor them, then these recommendations would require instrumentations in place, some kind of CMR, in order to comply with the proposal. GE could not accept this.

Mr. Wineman then explained the technical reasons why the working group disagrees with GE's issue.

Ms. Knife gave an example of a twin-engine aircraft with the latent condition of reduced stall margin. Consider an in-flight shut down on one engine (an active failure under the "golden rules") and reduced stall margin existing for any of a number of reasons on the other engine (latent condition). Then you fly into some environmental condition with a probability of 1 and have a surge and "loss of all thrust" which is a catastrophic condition. The recommendation would then require GE to install measuring devices to monitor the stall margin to ensure the failure probability is less than 10^{-3}, in order to prevent such a latency issue.

Mr. Knepper stated that this example seems to have three failures. If this is a dual-failure event, then the Latent recommendations apply, but a three-failure event would mean the recommended course of action does not apply. Mr. Wineman stated that loss-of-engine has to be a single event in order to be part of the assessment. The recommendation is looking at a much-less-probable condition—a single-failure condition—and not a multi-condition failure.

Mr. Kaszycki asked why did Cessna and Hawker Beechcraft disagree with the recommendation. Mr. Wineman stated that GE is the dissenting group with the most data, which GE used as proof that it would not be able to show compliance to the recommendation, even though it did show compliance. Mr. C. W. Robertson disagreed, that Cessna could not show compliance either. Mr. Wineman responded that the failure to show compliance is not related to the proposed criteria.

Mr. Robertson and Mr. Wineman then discussed the technical details of their disagreement. Mr. Robertson stated that Cessna's issue is not a workload issue, but a compliance issue.

Mr. Kaszycki suggested that the group discuss the details of this issue at a Working Group meeting.

Mr. Knepper proceeded to conclude the presentation (see Handout #3).

The working group asked permission to have two more meetings for Latency, and present recommendations by March, 2010. Mr. Wineman stated that, in the two meetings, the working group plans to achieve better understanding of the dissenting opinions, but would not change the "golden rules," even though Cessna and GE disagree with the rules.

Mr. Kaszycki asked why would the group not try to resolve *all* dissenting opinions in the additional time. Mr. Wineman and Mr. Knepper replied that there are too many dissenting opinions. At this time, given the resources remaining, the working group could only foresee resolving a limited portion of those dissension.

Mr. Barnett asked about the applicability statement for the Latency action, and wondered whether having such a statement would help towards resolving the dissension. Mr. Roberts replied that since Cessna and Hawker Beechcraft are the only two OEMs that would run into compliance problems, an applicability statement would not help.

Mr. Kaszycki stated that the FAA would allow the requested extension to March, 2010. He would like to see the simpler issues resolved, if possible. He would also like to see the final report address and disposition the dissenting opinions in detail. Finally, he asked the working group to address the potential cost associated with these recommended changes, since the changes must be cost-beneficial in order for the FAA to adopt them.

Mr. Knepper and Mr. Wineman agreed.

EXCOM Report

Mr. Bolt presented this report.

There has been no new EXCOM meetings since June's TAEIG meeting.

A sub-working group within EXCOM has been examining the ARAC process and procedures, and has been meeting via telephone every week. It will publish a Tasking in the Federal Register sometime in October, 2009.

The next scheduled EXCOM meeting will be in December, 2009.

Transport Canada Report

Mr. Oliver Rusch presented this report (see Handout #4).

Transport Canada is developing a new Electronic Flight Bag Advisory Circular. Since Transport Canada has a different structure than that of the FAA, this AC as it currently exists is not a perfect fit for Transport Canada.

Mr. Kaszycki asked what is the function of Transport Canada's aircraft evaluation group is? Answer: Mr. Rusch stated that this group is a part of the national aircraft certification branch, and its major functions include attendance at international MRB policy board meetings and at each aircraft MRB meeting. They also have a role in reviewing ICA's for acceptance in accordance with 52x.1529 and 525.1729.

Airworthiness Assurance HWG Report

Mr. R. Varanasi presented this report (see Handout #5).

The working group is currently working on the Aging Aircraft Safety Rule.

Airbus wanted to add additional items to the report. Mr. Varanasi stated that while Airbus's proposed items are good working principles for harmonization rulemaking in general, they are not necessary for the Aging Aircraft Safety Rule. The AAHWG is awaiting to resolve this issue.

Mr. Varanasi completed his action item and sent the letter to Mr. Kaszycki. Mr. Kaszycki stated he will review the letter with relevant people at a later time.

Mr. Kihm asked whether these are good questions to bring up at the CMR meetings. Mr. Kaszycki replied that the FAA could not require EASA to start this or that rulemaking; the harmonization effort is still in the relationship-building stage, where both entities are determining future procedures. However, industry should raise its concerns to EASA, and the FAA would support those issues that it agrees with.

Ice Protection HWG

Mr. Jim Hoppins presented this report. (See Handout #6.)

After the IPHWG Phase IV report was submitted on March, 2009, some new technical issues were raised by IPHWG members. These issues could not be resolved prior the

TAEIG meeting in June 2009. These issues were discussed during the June meeting. TAEIG voted to approve the report, but suggested that IPHWG review concerns to see if they could be reconciled. TAEIG voted to approve the report, with a letter discussing the presented concerns. A teleconference was planned by the IPHWG to initiate discussions on the concerns. At this time, the WG was notified by the FAA representative that since the FAA had accepted the TAEIG approval, the assigned tasking was completed. As such, the IPHWG had no authority to make further recommendations without new or amended tasking. Any further IPHWG meetings could not be for the purpose of obtaining a working group recommendations and that any FAA participation would need to be documented and included in the public records as required disclosure of "Ex Parte" contacts. However, some members are concerned about public release of data during such discussions. As such, no path is available for further IPHWG discussions. Furthermore, the rulemaking has entered the next stage so no more meetings could be authorized for the purpose of providing recommendations to the rulemaking. However, Mr. Kaszycki stated that the IPHWG could meet as an industry working group, with no need to disclose private data. The IPHWG could keep the FAA out of these discussions, and submit a report to the FAA afterwards with its results. The next opportunity to provide input would be during the public comment period on the SLD NPRM.

Mr. Hoppins would like to have Boeing take the lead in such an industry group (as the initiator of the concerns). He would be happy to participate. Mr. Kihm took an action item to pass this onto Boeing.

The Ice Protection HWG is officially concluded.

Avionics HWG

Mr. Clark Badie presented this report.

The AHWG will be meeting next week to get through a draft of the Appendices it was tasked to prepare.

An extension was granted to the comment period for § 25.1322, Flightcrew Alerting. The AHWG had discussed using red and amber lights in the cockpit. The published NPRM contained language that the AHWG disagreed with.

Mr. Badie stated that some members of the industry were unhappy with the changes in the Flightcrew Alerting NPRM. They expressed that if the NPRM were going to contain arbitrarily changed items, what is the point of having a working group to begin with?

Mr. Kaszycki stated in response that Phase 4 review is the working group members' final opportunity to see what would be closest to a final product, and the last opportunity to comment. Further, working groups are formed to make recommendations to the FAA; it is not an opportunity for industry to engage in negotiated rulemaking with the FAA. A Phase 4 review does not mean the FAA will change its position according to members' comments.

Any Other Business
None.

Action Item Review

Item	September 23, 2009 TAEIG Meeting Action Items	Status
1.	FAA (Mr. Wilborn) took an action item to discover what are the process for review of draft tasking on Low Speed awareness (*Federal Register* publication for comments, or other means).	DONE (email sent to Craig and Mike K 11/3/09)
2.	FAA (Mr. Kaszycki) and AAWG (Mr. Varanasi) to meet and review potential harmonization issues with EASA relating to Aging Aircraft Program. Mr. Kaszycki to update TAEIG at next meeting.	
3.	AAWG (Mr. Varanasi) to supply Airbus-supplied list of potential additional concerns regarding EASA harmonization.	Done
4.	FAA (Mr. Wilborn) to discover what the double asterisks refers to on the FAA project status sheet, and add a column on working methods (if known).	DONE (but WM update still pending)

Future TAEIG Meetings
The next meeting will be held in April 14, 2010, in Seattle. The meeting after that will be on October 6, 2010, in Washington DC.

Public Notification
The *Federal Register* published a notice of this meeting on August 31, 2009.

Approval
I certify the minutes are accurate.

Craig R. Bolt

Craig R. Bolt
Assistant Chair, ARAC

ATTENDANCE

NAME	ORGANIZATION	EMAIL	TELEPHONE
Oliver Rusch	Transport Canada		
Doug Kihm	Boeing		
C.W. Roberts	Cessna		
Craig Bolt	Pratt & Whitney		
Rolf Grenier	Airbus		
Mike Kaszycki	FAA		
James Wilborn	FAA		
Ray Hollander	NADA		
Roger Knepper	Airbus		
Bob Young	AIA		
Ralen Gao	FAA		
John Stift	ALPA		
Edward Wineman	Gulfstream		
Tom Peters	Embraer		
Keith Barnett	Bombardier		
Sarah Knife	GE		
Bob Park	Boeing		
Paul Mingler	GE		

September 2009 FAA Status Update

Transport Airplane and Engine Issues Group

Presented to: TAEIG

By: Mike Kaszycki, Manager, Transport Standards Staff

Date: September 23, 2009

September 2009 TAEIG Meeting

Topics:

- Rulemaking project status
- Non-rulemaking project status
- Rulemaking harmonization

September 2009 TAEIG Meeting

Rulemaking Project Status: (since June 2009)

- Part 25 related Final Rules
  - Part 25 Activation of Ice Protection Systems
    - Final Rule issued on 8/3/09
    - Effective 9/2/09

September 2009 TAEIG Meeting

Rulemaking Project Status: (since June 2009)

continued

- Part 33/35 related Final Rules
  - Fire Protection (33.17)
    - Issued 7/17/09

September 2009 TAEIG Meeting

Rulemaking Project Status: (since June 2009)

continued

- Part 25 Notices of Proposed Rule Making
  - Flightcrew Alerting (25.1322)
    - Published in Federal Register 7/9/09
    - Original 60 day public comment period closed 9/9/09
    - Comment period reopened for 15 days based on industry requests (closes on 10/1/09)
  - Maneuver Speed Limitation Statement (25.1583(a)(3))
    - Published in FR 9/4/09
    - 60 day public comment period closes 11/3/2009

September 2009 TAEIG Meeting

Rulemaking Project Status: (since June 2009)

continued

- Part 33/35 Notices of Proposed Rule Making
  - None

September 2009 TAEIG Meeting

Rulemaking Project Status: (since June 2009)

continued

Final Rules

- FRs on "Regulatory Hold"
  - None
- FRs in OMB/OST:
  - None
- FRs in Headquarters (HQ) for coordination:
  - 1 part 25/26 project
  - 1 part 33 / 35 project
- FRs in directorate coordination:
  - None
- FRs in development:
  - None

September 2009 TAEIG Meeting

Rulemaking Project Status: (since June 2009)

continued

<u>NPRMs</u>

- NPRMs open for comment
  - 2 part 25 projects
- NPRMs in OST/OMB:
  - 1 part 121 project
- NPRMs in HQ for coordination:
  - 1 part 25 project
- NPRMs in ARAC WG Phase 4 Review:
  - None
- NPRMs in Directorate for coordination:
  - 1 part 25 project

September 2009 TAEIG Meeting

Rulemaking Project Status: (since June 2009)

continued

<u>New Tasking</u>

- Part 25 Fuel System Lightning Protection
  - ARC chartered (August 20, 2009)
- Part 25 Low Speed Awareness & Alerting
  - ARAC tasking expected in early 2010
- Part 25 Airplane Performance Harmonization Efforts
  - NPRM development to begin in early 2010
- Part 25 Systems Harmonization Efforts
  - NPRM development to begin in mid 2010

September 2009 TAEIG Meeting

Rulemaking Project Status: (since June 2009)

continued

New Tasking

- Part 33 Rotor Integrity (Overspeed 33.27)
  - NPRM in development
- Airworthiness Directives Implementation
  - ARC Chartered (August 20, 2009)

September 2009 TAEIG Meeting

Non-Rulemaking Project Status: (since June 2009)

<u>Guidance and Policy</u>

- Part 25 Final Advisory Circulars (AC) issued:
  - None

- Part 25 Draft ACs issued:
  - Flightcrew Alerting (25.1322)
    - Issued July 9, 2009 for public comment in conjunction with NPRM

September 2009 TAEIG Meeting

Non-Rulemaking Project Status: (since June 2009)

<u>Guidance and Policy</u>

- Part 25/26 Final Policy issued:
  - Enhanced Airworthiness Program for Airplane Systems (EAPAS) Supplemental Type Certificate (STC) limitation
    - Issued June 10, 2009
  - Adding Part 26 to Type Certificate Data Sheets and Supplemental Type Certificates
    - Issued June 10, 2009

September 2009 TAEIG Meeting

Non-Rulemaking Project Status: (since June 2009)

Guidance and Policy (cont'd)

- Part 25/26 Final Policy issued:
  - – Evaluating Deployment Mechanisms for Potential Injury Hazards
    - Issued July 20, 2009
  - – Fuel Tank Flammability Reduction (FTFR)
    - Issued July 21, 2009

September 2009 TAEIG Meeting

Non-Rulemaking Project Status: (since June 2009)

Guidance and Policy (cont'd)

- Part 25 Draft Policy issued:
  - Flammability Testing of Interior Materials
    - Issued August 24, 2009 for public comment

September 2009 TAEIG Meeting

Non-Rulemaking Project Status: (since June 2009)

Guidance and Policy

- Part 33 Final Advisory Circulars (AC) issued:
  - Guidance for 30-Second and 2-Minute One-Engine-Inoperative (OEI) Ratings for Rotorcraft Turbine Engines (33.7)
    - Issued June 11, 2009
  - Guidance Material for Aircraft Engine Life-Limited Parts Requirements (33.70)
    - Issued July 31, 2009

September 2009 TAEIG Meeting

Non-Rulemaking Project Status: (since June 2009)

Guidance and Policy

- Part 33 Final Advisory Circulars (AC) issued:
  - Engine Fire Protection (33.17)
    - Issued August 3, 2009
  - Comparative Endurance Test Methods for Parts Manufacturer Approval of Turbine Engine and Auxiliary Power Unit Parts (33.87)
    - Issued June 25, 2009

September 2009 TAEIG Meeting

Non-Rulemaking Project Status: **(since June 2009)**

<u>Guidance and Policy</u>

- Guidance for Parts Manufacturer Approval of Turbine Engine and Auxiliary Power Unit Parts under Test and Computation (33-8)
  - Issued August 19, 2009

September 2009 TAEIG Meeting

Non-Rulemaking Project Status: (since June 2009)

Guidance and Policy

- Part 33 Draft ACs issued:
  - None

September 2009 TAEIG Meeting

Non-Rulemaking Project Status: (since June 2009)

<u>Guidance and Policy</u>

- Part 33 Final Policy issued:
  - None
- Part 33 Draft Policy issued:
  - None

September 2009 TAEIG Meeting

- **Rulemaking Harmonization**
  - Flightcrew Alerting (25.1322)
    - FAA will share comment disposition with EASA
    - FAA and EASA continuing to discuss wording to maintain intent
  - FAA plans to publish NPRM enveloping CS 25.1302
  - FAA 4 year rulemaking plan calls for start of 5-7 harmonization projects

September 2009 TAEIG Meeting

- **Rulemaking Harmonization (con’td)**
  - The FAA met with EASA, and TCCA in Ottawa in July to coordinate on 4 year rulemaking and guidance plans, compare inventories, and identify working methods
    - Continued semi-annual meetings planned, next meeting scheduled for January 2010
  - Next meeting of the Certification, Rulemaking, and Maintenance Team (CMRT) will be in October 2009 in Washington, DC

ASAWG Task#4 Status

TAEIG 11 Jun 09

Table of Content

Reminder:
- ARAC Specific Risk Tasking
- Task#3 Executive Summary

Overview:
- ASAWG Task#4 Planning
- ASAWG Task#4 Report Common Format Template

Each Task Group:
- Task#4 Status
- Task#4 Planning

Statement of Issue

- Previous ARAC harmonization working groups, and regulatory agencies, produced varying recommendations to handle specific risk
- Aircraft are becoming increasingly integrated where individual system functional boundaries may not be well defined
- Inconsistencies in the safety analysis across systems could result in the use of non-standardized system safety assessments across various critical systems making it hard to properly evaluate at the aircraft level

SPECIFIC RISK TASKING

- FAA Notice on 3/21/06 - ARAC Tasking to TAEIG
  - Task#1 - Develop definition(s) and examples
  - Task#2 - Review of existing material and identify industry application
  - Task#3 - Determine adequacy of existing and proposed regulatory and guidance material
  - Task#4 - Develop recommendations for rulemaking and guidance material

SPECIFIC RISK TASKING

- ASAWG Formulation on 7/25/06 – TAEIG Tasking to ASAWG
  - Co-Chairs
    - Roger Knepper – Airbus
    - Ed Wineman - Gulfstream
  - 18 Total members
    - 7 Airframers
    - 5 Suppliers
    - 4 Regulatory
    - 2 Users
  - Over 32 SMEs identified with half currently active in covering both operations and design

ASAWG Status - Task#3
(Executive Summary)

- The ASAWG reviewed during Task#3 the results of Tasks#1 & 2 and assessed the appropriateness, adequacy, and consistency of the relevant existing regulations, existing guidance material, ARAC recommendations, and industry practices for airplane-level safety analysis.
- The key approaches to addressing Specific Risk were identified as “fundamental issues”.
- Each fundamental issue recommendation for Task#4 was developed and reviewed by industry and regulators.
- This review generated comments, the disposition of which is documented in the report.
- The recommendations give rationales to go forward to Task#4 and announce, if the change of regulations/guidances are expected or not.

ASAWG Status - Task#3
(Executive Summary)

The final recommendations from Task#3 focus on establishing consistent guidance / regulation for:

- Conducting specific risk evaluations of latent and active failures.
- Conducting specific risk evaluation for dispatch under a MEL.
- FHA development when dealing with intensifying factors such as flight length, flight phase and diversions.
- Documenting component life limits that are necessary to protect against aging and wear out.

These recommendations for Task#4 demonstrate where a more consistent approach across systems is necessary to:

- Assure a warranted level of specific risk regulation, i.e. inconsistency potentially results in over- or under-regulation, and
- Avoid undue burden on the applicant and regulatory authorities.

ASAWG Way Forward - Task#4

TASK	DESCRIPTION	DATE
3	Determine adequacy of the existing/proposed standards and if a change is warranted	MAR 2008
4	Prepare a report identifying recommendations	**Sep 2009**

Task#4 schedule:

- Meeting #8 complete
- Meeting #9 complete
- Meeting #10 Hamburg complete
- Meeting #11 Phoenix 07 to 09 Apr, 2009
- Meeting #12 Cedar Rapids 07 to 09 Jul, 2009
  Final Report to TAEIG Sep, 2009
- ASAWG Report presented to TAEIG Oct, 2009

ASAWG Task#4 Report Common Format Template

I. Executive Summary

II. Benefits of the Recommended Changes

III. Applicability of the Recommended Rules/ACs

IV. The Recommendations

V. General Comments on Costs and Benefits (beyond Section II above) of the Recommendations.

VI. Alternatives Considered

VII. Dissenting Opinions

ASAWG Status – Task#4
- Flight time, MMEL, Ageing & Wear -

Material that follows is in draft

Organizations provided positions and proposed modifications to draft Phoenix Task#4 Report

ASAWG will disposition comments and determine consensus at Cedar Rapids meeting prior to final Task #4 release

ASAWG Status – Task#4

Flight Time Task Group

Planning - Flight Time Task

Two change recommendations were established:

- Clarify Section 10, 11 and Appendix 4 Tables of AC 25.1309 Arsenal
- Incorporate the use of mission time and diversion time in ETOPS safety analysis defined in AC 1535-1X

Task #4 Report Drafted (Phoenix outcome):

Microsoft
Word-Dokument

Positions provided by organizations:

- 6 agree (2 Industry, 4 Regulators), 3 partially agree (Industry), 2 disagree (Industry)

Final Tasking:

- ASAWG to disposition comments at Cedar Rapids and determine consensus
- Establish Final Task#4 release at Cedar Rapids

ASAWG Status – Task#4

MMEL Task Group

Status – MMEL

Two change recommendations were established:

- Recommendations to Industry and the Authorities (FAA Flight Standards, EASA, TCCA, etc.) for potential incorporation into MMEL Development Process
- Change to AC 25.1309 Arsenal

Task #4 Report Drafted (Phoenix outcome):

Microsoft
Word-Dokument

Positions provided by organizations:

- 6 agree (4 Industry, 2 Regulators), 3 partially agree (1 Industry, 2 Regulators), 1 disagree (Industry)

Final Tasking:

- ASAWG to disposition comments at Cedar Rapids and determine consensus
- Establish Final Task#4 release at Cedar Rapids

ASAWG Status – Task#4

Aging & Wear Sub-Task Group

Status – Aging & Wear

Change recommendation was established:

- Clarify appendix 3, b (1) of AC 25.1309 (Arsenal) for the consideration of system component ageing & wear aspects

Task #4 Report Drafted (Phoenix outcome):

Microsoft
Word-Dokument

Positions provided by organizations:

- 8 agree (4 Industry, 4 Regulators), 1 partially agree (Industry),
  1 disagree (Industry)

Final Tasking:

- ASAWG to disposition comments at Cedar Rapids and determine consensus
- Establish Final Task#4 release at Cedar Rapids

ASAWG Status – Task#4
- Latent/Active Task Group -

Material that follows is in draft

Organizations to provide positions and to propose modifications for Cedar Rapids

Status - Latent/Active

General Task 4 Objective:

- Generate a single methodology that controls specific risk through limiting latency and limiting residual risk.
  - Existing simple proven mechanical / hydro systems must be encompassed within the methodology

Status:

- Preliminary flowchart developed in Phoenix. Proposed new subparagraph added to 25.1309, and new Chapter added to AC25.1309-Arsenal.
- Open items on critical path:
  - Finish developing new Specific Risk material in 25.1309 and AC 25.1309 Arsenal
  - Finish revising “affected” regulations and advisory materials to “point to” 25.1309 (rule and advisory material) for latent failures

Status - Latent/Active

Status:

- Draft revision proposals for 25.1309 and AC 25.1309 Arsenal
- Draft revisions of affected regulations and advisory material to be revised to “point to” 25.1309 (rule and advisory material) for specific risk of latent failures (other aspects of these rules remain as they are)

Microsoft Word-Dokument

Microsoft Word-Dokument

Regulations / advisory material affected

To accomplish the tasking, the following regulations and advisory material need to be revised to “point to” 25.1309 (rule and advisory material) in regards to how specific risk **<u>of latent failures</u>** is addressed.

Some of proposed changes are not applicable to the corresponding CS documents.

A separate, similar list for those CS documents will be created.

• FAR 25.671(c)(2)	revised to “point to” 25.1309
• FAR 25.1309(b)	revised to include latent specific risk
• FAR 25.629(d)	no revision required
• FAR 25.783	revised to “point to” 25.1309
• FAR 25.901(c)	revised to “point to” 25.1309 (except for 3 specific cases)
• FAR 25.933	revised to “point to” 25.1309
• FAR 25.981(a)(3)	proposal for revision pending
• ARAC 25.671	revised to “point to” 25.1309
• ARAC 25.933 Rule and AC	proposal for revision pending
• AC 25-19 – CMRs	no revision
• AC 25.629-1A	deleted some text dealing with single + probable
• AC 25.1309-1A	replace with SDAHWG recommended AC 25.1309-Arsenal with changes
• AC/AMJ 25.1309 Arsenal	revised to include latent specific risk
• ARAC AC 25.901(c)	no revision required
• FAA Policy 25.901(c)	superseded by proposed 25.901(c) rule change
• §25.1709	proposal for revision pending

SUMMARY

- MMEL, Flight Time, and Aging/Wear have (good) chance of consensus
  - They have reasonably solid Task 4 reports out of Phoenix
  - Received company reviews and inputs following Phoenix
  - Team to disposition comments and determine consensus in Cedar Rapids

- **Latent/Active:**
  - Recommendations have yet to solidify
  - Prepare draft Task#4 report at Cedar Rapids. No more meetings are planned.
  - Establish Final Task#4 release up to mid Sep 09
  - **At High risk not to achieve consensus**

Final Task #4 Report Issued by Sep 2009

ASAWG Task#4 Status

TAEIG 23 Sep 09

Table of Content

ARAC Specific Risk Tasking Statement of Issue

- Previous ARAC harmonization working groups, and regulatory agencies, produced varying recommendations to handle specific risk
- Aircraft are becoming increasingly integrated where individual system functional boundaries may not be well defined
- Inconsistencies in the safety analysis across systems could result in the use of non-standardized system safety assessments across various critical systems making it hard to properly evaluate at the aircraft level

ARAC Specific Risk Tasking

- FAA Notice on 3/21/06 - ARAC Tasking to TAEIG
  - Task#1 - Develop definition(s) and examples
  - Task#2 - Review of existing material and identify industry application
  - Task#3 - Determine adequacy of existing and proposed regulatory and guidance material
  - Task#4 - Develop recommendations for rulemaking and guidance material

ARAC Specific Risk Tasking

- ASAWG Formulation on 7/25/06 – TAEIG Tasking to ASAWG
  - Co-Chairs
    - Roger Knepper – Airbus
    - Ed Wineman - Gulfstream
  - 18 Total members
    - 7 Airframers
    - 5 Suppliers
    - 4 Regulatory
    - 2 Users
  - Over 32 SMEs identified with half currently active in covering both operations and design

Task#4 (Executive Summary)

Task#4 recommendations demonstrate where a more consistent approach across systems is necessary to:

- Assure a warranted level of specific risk regulation, i.e. inconsistency potentially results in over- or under-regulation, and
- Avoid undue burden on the applicant and regulatory authorities.

Aging & Wear, MMEL and Flight & Diversion Time:

- The ASAWG concluded on change recommendations for
    - Aging & Wear,
    - MMEL,
    - Flight & Diversion Time.

  Note: The change recommendations are related to the latest SDAHWG's Arsenal version of AC25.1309. Certain aspects of the MMEL change recommendation should be established in accordance with the recommendations contained in FAA Flight Standards Policy.

Latent & Active Failure:

- The ASAWG could not conclude on change recommendations.

Task#4 Report
Common Format Template

I. Executive Summary

II. Benefits of the Recommended Changes

III. Applicability of the Recommended Rules/ACs

IV. The Recommendations

V. General Comments on Costs and Benefits (beyond Section II above) of the Recommendations.

VI. Alternatives Considered

VII. Dissenting Opinions

Task#4 Final Recommendations
- Flight time, MMEL, Ageing & Wear -

Organizations provided positions and proposed modifications to draft Phoenix meeting Recommendations

ASAWG polled on positions and proposed modifications at Cedar Rapids meeting

Final Recommendations were revised according to polling outcomes and organizations dissenting opinions are captured in the final report

Task#4 Final Recommendations

Aging & Wear

Aging & Wear

Final recommendation:

- Clarifies appendix 3, b (1) of AC 25.1309 (Arsenal) for the consideration of system component aging & wear aspects.
- Note: Although it is recognized that a revision of 25.1529, AC 25.19 and App. H 25.4 is out of the scope of the ASAWG ARAC tasking, the recommended changes provided in this section may require revision of 25.1529, AC 25.19 and App. H 25.4.

Benefits:

- The proposed change increases safety by providing applicants and regulators clear guidance that can be applied consistently across systems to ensure consistent documentation of system component replacement times that are necessary to protect against aging and wear out.

Applicability:

- These changes will apply to new TC or STC and will not be applied retroactively.

Aging & Wear

Dissenting opinions:

- ANAC/EASA/FAA/TCCA
  - Concern is about common cause aging/wear affecting multiple components.
- DASSAULT AVIATION
  - Concern is about overlapping responsibilities between Certification and Maintenance (MRB) of ALI determination.

ASAWG recommendations to TAEIG:

- No change of final recommendation and herewith addressing the dissenting opinions in accordance with the polling result from ASAWG at Meeting#12 (Jul. 7-9, 2009 - Cedar Rapids/IA, USA)

Task#4 Final Recommendations

MMEL

MMEL

Final recommendation:

- Proposes an uniform approach for assessing quantitatively specific risk under MMEL dispatch, for implementation as a Flight Standards guidance,
- Clarifies the relationship between type design certification requirement and the proposed Flight Standards guidance by recommending changes to the Arsenal version of AC 25.1309, paragraphs 12.b.(1) and paragraph 12.d., and the current AC 25.1309-1A, paragraph 12.d.

Benefits:

- When used to support a proposed MMEL item's qualitative assessment, the recommended numerical analysis guidance would provide a standardized methodology that would maintain fleet average reliability objectives.

Applicability:

- These changes will apply to new TC or STC and is not intended to be applied retroactively, unless requested by the applicant.

MMEL

Dissenting opinions:

- BOEING (dissenting opinions #1 and #2)
  - Concerns are about potential misinterpretation of the proposed wording

ASAWG recommendations to TAEIG:

- Boeing dissenting position#1:

  ASAWG considers that technical agreement have been reached amongst OEM and Authorities. However, to avoid misinterpretation from people not participating to the group, ASAWG recommends that an explanatory note TBD be added with potential update of the flowchart.
- Boeing dissenting position#2:

  No change of final recommendation and herewith addressing the dissenting opinions in accordance with the polling result from ASAWG at Meeting#12 (Jul. 7-9, 2009 - Cedar Rapids/IA, USA)

Task#4 Final Recommendations

Flight Time

Flight Time

Final recommendation:

- Clarify section 10 of AC 25.1309 (Arsenal) for the consideration of intensifying and alleviating factors particularly with respect to flight duration, flight phase, and diversion time.
- Clarify section 11 of AC 25.1309 (Arsenal) for how environmental or operational factors are combined with single failures to address inconsistency that has caused misunderstandings between the regulators and applicants.
- Revise Appendix 4 tables of AC 25.1309 (Arsenal) to clearly focus on environmental conditions and operational factors.
- Revise ETOPS AC 1535-1X Chapter 3 Paragraph 16.a (3) and (4) for the use of mission time and diversion times in ETOPS safety analysis.

Flight Time

Benefits:

The proposed changes increase safety through elimination of errors in the application of the guidance and by providing applicants and regulators clear guidance that can be applied consistently across systems.

- Treat flight time, flight phase and diversion time in the FHA in same manner across applicants and across systems from a single applicant.
- Ensure correct hazard classification in FHAs take into account intensifying factors, such that specific risk concerns worthy of being addressed are not overlooked.
- Eliminate confusion with respect to the compounding nature of factors in defining the hazard classifications in an FHA.
- Eliminate the misunderstandings due to unclear guidance on how environmental or operational factors are combined with single failures.
- Appendix 4 tables of AC 25.1309 (Arsenal) modified to eliminate confusion between failures and environmental conditions and operational factors.
- Harmonized use of average long-range flight duration and maximum diversion time for both type 1 and type 2 systems in compliance to the new ETOPS rule (25.1535).

Applicability:

- These changes will apply to new TC or STC and will not be applied retroactively.

Flight Time

Dissenting opinions:

- ANAC/EASA/FAA/TCCA
  - on HIRF and Lightning Recommendations
  - on the ETOPS recommendation
    - Concerns are about removing considerations of H/L from 25.1309 analysis, and ETOPS wording does not match operations rules.
- GARMIN
  - on changes to AC25-1309 paragraph 11g
    - Concern is about restriction on combining high probability external events with single failures.

ASAWG recommendations to TAEIG:

- No change of final recommendation and herewith addressing the dissenting opinions in accordance with the polling result from ASAWG at Meeting#12 (Jul. 7-9, 2009 - Cedar Rapids/IA, USA)

Task#4 Latent

Status

Task#4 Latent - Status

Outcome Cedar Rapids Meeting:

- Industry and Regulators established “compromise positions”.
- Although both sets of compromises brought the issues closer, the gap could not be closed at the meeting.
- Due to time constraints, i.e. the compromises were discussed on the last day of the meeting, the WG declared an impasse.

Latent Task Force:

- Several ASAWG members expressed a desire to re-open dialogue on specific risk due to latency.
- Latent Task Force created with the objective to establish agreements for latency that both Industry and the Regulators can achieve a consensus on.

  These agreements serve as basis for the final specific risk criteria for latency and the classic meaning of the agreements shall not be changed.

Task#4 Latent - Status

Latent Task Force Outcome:

- Agreements on following topics
  - All other regulations and advisory material would be revised to “point to” 25.1309 (rule and advisory material) in regards to how specific risk <u>of latent failures</u> is addressed.
  - Addition of new 25.1309(b)(4) to prescribe quantitative limit latency criteria and quantitative residual risk criteria
  - Revision of the SDAHWG’s Arsenal version of AC25.1309 to include qualitative guidance for limit latency best design practice and philosophy

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Task#4 Latent - Status

ASAWG Polling on Sep 16th to determine if a consensus has been reached on latent task force outcome:

- 14 out of 17 organizations participated at the polling
- Polling outcome
  - OEMs agreed (5): Airbus, Boeing, Dassault, Embraer, Gulstream
  - OEMs disagreed (2): Cessna, Hawker Beechcraft
  - Regulators agreed (4): ANAC, EASA, FAA, TCCA
  - Suppliers agreed (2): Garmin, Rockwell Collins
  - Suppliers disagreed (1): GE

11 out of 14 accepted to develop final latent change recommendation in accordance with latent task force outcome

SUMMARY

MMEL, Flight Time, and Aging/Wear

- ASAWG concluded on change recommendations
- ASAWG provided recommendations to TAEIG regarding dissenting opinions
- ASAWG is asking for TAEIG's approval of the Final Report for the above 3 areas, and transmittal to the FAA

Latent/Active:

- ASAWG reached majority on latent task force outcomes
- ASAWG is asking TAEIG to extend the project to 2 additional meetings. The final change recommendation to be available by End Mar 2010

MPS-750
(04/2009)

TCCA Report

TAEIG Sept 23rd 2009

TCCA/EASA BILATERAL TREATY

- At the Canada – European Union Economic Summit held May 6, 2009 in Prague, the Canada – European Union (EU) Agreement on Civil Aviation Safety was signed, enabling the Agreement to be presented to the Canadian and EU Parliaments for ratification.
- The Agreement provides for the possibility of reciprocal acceptance of certain certificates without being subject to a level of review or issue of a corresponding approval.





EASA/FAA/TCCA COOPERATIVE RULEMAKING MEETING

- **Held July 15 – 16, 2009 in Ottawa**
- **Increase harmonization and reduce costs via reduction of redundant effort among participants**
- **Next meeting : January in Cologne**

Electronic Flight Bags

- Transport Canada is working on a new advisory circular (AC) to reduce Transport Canada's reliance on FAA AC 120-76A, which is referenced in two TCCA documents :
  - CBA AC No. 0231, which addressed operations considerations.
  - AC PL 500-017, which addressed certification considerations.
- FAA AC 120-76A is not directly applicable in Canada as the specified processes are particular to the FAA organization and to the FAA Aircraft Evaluation Group. The TCCA Aircraft Evaluation Group is not functionally equivalent to the FAA.
- As part of Transport Canada's AC development activity we are consulting our AC with the FAA EFB core group.

Canada

AAWG Report to TAEIG September 23, 2009

Dr. Rao Varanasi

Co Chair

Airworthiness Assurance Working Group (AAWG)

Airworthiness Assurance Working Group

- Membership
- Meetings
- Current Task
- Status

AAWG Membership

- ANA wishes to participate in fully in AAWG meetings
- Recognizing that AAWG is nearing the end of its current FAA task, ANA wishes to attend the AAWG meetings as an Observer now; later intends to go through with a formal application process for membership.
- ANA attended the August 2009 AAWG meeting.

AAWG Membership: No changes

Name	Company	AAWG Member	E-mail Address
Rao Varanasi	Boeing	Yes (Co-Chair)	rao.varanasi@boeing.com
Roger Skinner	Boeing	No	roger.a.skinner@boeing.com
Andreas Behrmann	Airbus	Yes	andreas.behrmann@airbus.com
Ralph Sykes	LMCO	Yes	r.sykes@LMCO.com
Mark Yerger	FedEx	Yes (Co-Chair)	Mdyerger@fedex.com
Phil Ashwell	British Airways	Yes	**phil.b.ashwell@britishairways.com**
Joe Moses	Continental Airlines	Yes	joe.moses@coair.com
Greg Pattison	Northwest Airlines	Yes	greg.pattison@nwa.com
Ed Walton	UPS	Yes	emwalton@ups.com
Harry Demarest	American Airlines	Yes	H.a.demarest@aa.com
Jon Oberdick	US Airways	Yes	jober@usairways.com
Larry Williams	United Airlines	Yes	Larry.Williams@united.com
Jun Yamanaka	Japan Airlines	No	jun.yamanaka@jal.com
Shinichi Yoshizaki	ANA	No	s.yoshizaki@ana.co.jp
Joe Freese	ABX Air	Yes	joe.freese@abxair.com

AAWG Membership (cont'd)

Name	Company	AAWG Member	E-mail Address
Greg Schneider	FAA	Yes	greg.schneider@faa.gov
Rusty Jones	FAA	No	Rusty.Jones@faa.gov
Paul Tang	Transport Canada	Yes	TANGP@tc.gc.ca
Richard Mintor	EASA	Yes	richard.minter@easa.europa.eu
Michael Tallarico	US Airways	No	michael.tallarico@usairways.com
Ethan Brandon	Lynden Air Cargo	No	ebrad@lynden.com
Mitch Lineberry	US Airways	No	Mitch_lineberry@usairways.com
Rafael Marques	Embraer	No	rafael.marques@embraer.com.br
Ron Pekny	American Airlines	No	Ron.Pekny@aa.com
Ian Won	FAA	No	Ian.Y.Won@faa.gov
Phil Yannacone	American Airlines	No	Phil.Yannaccone@aa.com
Mark Eldred	Continental Airlines	No	Mark.eldred@cal.com

Meetings

- There was one meeting of the AAWG on August 5, 2009 since the last TAEIG meeting in June 11, 2009
- The next AAWG meeting is tentatively scheduled in February 2010 at the Airbus facility in Miami.

Current Tasks

- AASFR Task:
  - Tasked - May 13, 2004;
  - Status - In work and on schedule;
  - Two Phases:
    - Phase 1 is complete as of April 2007
    - Scheduled Completion for Phase 2 is December 2009- Task 4
      - Development of model specific programs
      - AAWG to provide oversight function and guidance for some STG technical issues

.

Task 4
AAWG Discussions

- Technical Guidance Provided to STGs:
  – A Means of Compliance (MOC) for deviations from AC 120-93 Guidance
    - Grace periods for Operator incorporation of existing SBs revised with Damage Tolerance Inspections (DTI)
  – MOC for Replaceable Structural Components (RSC)
- Rule Issues Requiring TAEIG Help:
  – Non harmonized elements of FAA/EASA Aging Airplane Rules, remain as a concern to DAHs and Operators

Questions?

18 March 2009

IN REPLY, REFER TO
L374-44-09-001

Mr. Craig R. Bolt
Assistant Chair
Advisory Committee on Transport Airplane & Engines Issues Group (TAEIG)
Pratt & Whitney
400 Main Street
East Hartford, CT 06108

Ref: L374-44-05-003, dated 19 September 2005 (Submittal of Task 2, Rev. n/c)
L374-44-05-004, dated 23 December 2005 (Submittal of Task 2, Rev. A)

Dear Mr. Bolt:

This letter is provided for closure of the Phase IV review of IPHWG Task 2. The Phase IV review was requested due to the immature state of large drop icing simulation and compliance methods at the time of Task 2 report submittal (references above). The Phase IV review consisted of a review of current status of simulation and compliance methods, as well as a review of the preliminary Regulatory Evaluation. There are still concerns regarding the maturity state, and as such interim guidance materials are recommended.

Airframe Icing Simulation & Compliance Methods

The analytical and simulation techniques for predicting large drop ice accumulations have matured since the original Task 2 report was submitted (Dec 2005). However, there are still significant challenges in simulating large drop accretions and, consequently, in showing compliance to all aspects of the rule.

In addition, the FAA has drafted a proposed rule that modifies the rule applicability from application to all Part 25 aircraft to a subset of aircraft with a maximum takeoff weights of less than 60,000 lbs, or the use of reversible flight controls (regardless of weight). Consequently, the rule is primarily applicable to smaller Part 25 aircraft such as business jets and regional commuter aircraft. Many of these aircraft are expected to be certified on a “detect and exit” basis with respect to the large drop environment.

The interim materials were drafted with a focus on how to show compliance for these “detect and exit” aircraft, as well as for aspects of the rule package with which all airplanes must comply, using currently available simulation methods. The intent is that these materials would be appended to the draft advisory materials proposed in the IPHWG Task 2 report (Appendix K).

When operated on a “detect and exit” basis, affected aircraft will have limited exposures and limited accumulations due to the large droplet conditions. The IPHWG determined that the use of existing simulation methods alone may be an acceptable means of compliance when used in a conservative manner as discussed in the interim guidance. The IPHWG recommends that these compliance methods may provide sufficient accuracy to certify aircraft operated in this manner without requiring flight tests in natural freezing drizzle and freezing rain conditions. However, the IPHWG acknowledges that the tool maturity is not sufficient to support unrestricted operations (including unrestricted in a portion of the large drop environment) without certification flight tests in natural freezing drizzle and freezing rain conditions.

Some manufacturers have concerns that the applicability provisions will not be accepted by all certifying authorities. If the applicability provisions of the FAA draft rule are not accepted by international authorities, the means of compliance for the larger aircraft to operate unrestricted, as indicated above, will require flight tests in natural large drop conditions. Per current understanding, this rulemaking project is not on the EASA work list at this time. As such, there is still considerable uncertainty with respect to harmonization of the applicability provisions of the rule.

Given the current state of funding for icing research, the ability to continue to mature the simulation methods will be limited. As such, the interim methods of compliance may be required for the foreseeable future.

Engine/Engine Installation Compliance Methods

The proposed standards for SLD and mixed phase icing conditions effects on engines were developed when industry, EASA, Transport Canada, and the FAA combined together as an engine and engine installation subgroup under the Ice Protection Harmonization Working Group. A thorough review of service experience in conjunction with meteorological data was used to develop propulsion rules and guidance material for these weather conditions.

For Propulsion systems, SLD is addressed in proposed rule changes for 14 CFR Part 33, sections 33.68 and 33.77, and 14 CFR Part 25, section 25.1093. Mixed phase and ice crystal conditions are addressed in proposed rule changes for 14 CFR Part 33, section 33.68, and 14 CFR Part 25, section 25.1093. Engine and engine installation certification to Appendix X of part 25 and Appendix D of part 33 require that the plane operate safely throughout these icing envelopes. The subgroup reached a consensus on a proposed revision to AC 20-147.

It contains acceptable compliance methods that rely on similarity analysis for mixed phase and ice crystal conditions. The proposed text change to § 25.903 is consistent with the current § 25.903, and allows flexibility for installation of pre § 33.68 certification basis engines into new aircraft applications at the FAA's discretion. For 14 CFR 33 engine rules, the JAA/EASA is expected to maintain equivalency to FAA rules, and not direct similarity. This equivalency allows for all manufacturers to continue their equivalent methods of compliance demonstrations. In the future the subgroup anticipates the guidance material will be updated as industry and authorities advance in their understanding of mixed phase and ice crystal conditions and as engineering tools for compliance with the proposed rules are improved.

<u>Flight Test Compliance Methods</u>

The 14 CFR 25 Subpart B Flight recommendations were not altered as part of this review. Compliance methods are largely based on flight tests with simulated ice shapes to evaluate the performance and handling quality effects. The maturity concerns are with respect to creation of the simulated ice shapes and not with the flight evaluation requirements.

<u>Regulatory Evaluation</u>

The IPHWG reviewed a draft copy of the APO regulatory analysis and provided comments and recommendations. A summary of open comments is provided by attachment.

<u>Recommendation</u>

While the final outcome of the APO analysis is still in work, the technical aspects of the interim materials have agreement within the IPHWG and are recommended for approval by TAEIG for transmittal to the FAA for rulemaking.

Sincerely,

Jim Hoppins
Co-Chair Ice Protection
Harmonization Working Group

Attachments:

A. Results of IPHWG review of draft regulatory evaluation

B. Interim guidance materials to be added to AC 25-XX
(IPHWG Task 2 report, Appendix K)

Results of IPHWG Review of Draft Regulatory Evaluation

A draft summary of the regulatory evaluation was provided to the IPHWG for review. The following recommendations were provided:

- The development of the affected fleet included aircraft that would not be affected by the rule, due to maximum takeoff weights exceeding 60,000 lbs. Recommendations were made with respect to categorizing aircraft based on the MTOW, usage and the use of reversible flight controls.
- IPHWG members provided input to improve the accuracy of the delivery numbers for affected aircraft.
- There were concerns that only looking at new type certificates as a basis for applicable aircraft (with increased certification costs) would not accurately address potential certification efforts driven by the changed product rule (§21.101).
- All of the applicable events in the regulatory analysis were considered as catastrophic events. However, two of the events in the analysis resulted in aircraft damage, but did not result in fatalities. The rationale for inclusion of these events on a catastrophic basis is unclear.
- Some IPHWG members do not concur that the Cessna 560 Eagle River event is applicable to the cost and benefit analysis. Icing was indicated in this event but was not cited as the probable cause. A consensus was not reached on the removal of the event from the cost and benefit analysis.
- The estimated passenger loading for small Part 25 aircraft was estimated based on the maximum number of seats certified. The majority of small Part 25 aircraft are delivered with executive seating arrangements which reduce the passenger load. Recommendations were provided.
- The IPHWG has concerns that the Taiwanese study used as a basis for estimating a reduction of passenger demand following a catastrophic event may not accurately indicate the US market. Statistics for the US are available from the DOT Bureau of Transportation Services which maintains records for “passenger enplanements” available through the internet. A brief review by IPHWG indicated seasonal variation of enplanements that would be difficult to attribute to the cited effect of reduced passenger demand following a catastrophic event. Further review is recommended.
- Recurrent costs for SLD ice detectors were not included in the analysis. IPHWG recommendation was to assume 50% of the aircraft would use SLD ice detectors and 50% would use visual cues.
- The use of the 2006 GA Survey to determine the annual flight hours for smaller airplanes (393 hours) affected by the rule may be biased by the smaller single engine aircraft within the GA fleet. Many of the applicable small Part 25 aircraft are operated under a fractional share basis and accumulate significantly greater hours than an individual operating a single engine piston aircraft.
- It is not clear how US manufactured aircraft versus non-US manufactured aircraft are being accounted for in the international impact statement. The fleet definitions contain a mix of both types.
- Additional detail level comments have been provided to the economist through the IPHWG FAA representative for resolution.

Appendix to AC 25.XX

Capabilities of Engineering Tools for Compliance with the Appendix X Requirements of Part 25

1. Assessment of Engineering Tool Capabilities

This appendix is the result of an ARAC Ice Protection Harmonization Working Group (IPHWG) 2009 evaluation of the engineering tool capabilities with respect to the prediction of Appendix X ice accretions and icing effects. The intent of this appendix is to provide interim guidance on the use of the tools.

Table 1 provides a graphical assessment of the capabilities of engineering icing tools. The capability of each tool for the various applications is classified as either Green, Yellow, or Red, as described in the Legend. As discussed in the main body of the AC, reliance upon the available simulation methods combined with engineering judgment will be required for finding compliance to the Appendix X requirements of Part 25. Even though a simulation tool type is classified as Green, an applicant must ensure that the specific tool is appropriate for their application and is used in a conservative manner, including critical-case icing conditions. General and specific concerns that should be considered are discussed later in this appendix. Section 2 of this appendix provides guidance on the tools, capabilities, and best practices for tool use with respect to Appendix X conditions. Section 3 discusses means of compliance for specific airplane components. Sections 4-6 discuss means of compliance for each of the three certification options of §25.1420. Section 7 discusses means of compliance for air data sensors and windshields (§§25.1323, 25.1325, and 25.773). Section 8 defines standard roughness levels.

Table 1 illustrates the current state of simulation capabilities. It is expected that capabilities will improve in the future. Applicants and research agencies are encouraged to develop and validate the engineering tools currently classified as Yellow and Red.

Interim Guidance Materials

		Unprotected Areas				Protected Areas					Detection Methods			Air Data Sensors	
		Wing	Tail	Radome	Non-lifting Surfaces (antenna, inlets, external modifications)	Thermal (protected area)	Thermal (Aft of protected area)	Mechanical (protected area)	Mechanical (aft of protected area)	Fluid Freezing Point Depressant	Visual Cues (Reference Surface)	Instrument (position or installation effects)	Instrument (performance)	Instrument (position or installation effects)	Instrument (performance)
FZDZ MVD < 40µm	Icing Tunnels	Green	Green	Orange *	Green	Green	Green	Green	Green	Green	Green / Yellow *	Green / Orange *	Green	Green / Orange *	Green
	Codes	Green	Green	Yellow	Green / Orange **	Green	Orange	Orange	Orange	Green	Green / Yellow **	Green	Orange **	Green	Orange
	Tankers	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange
FZDZ MVD > 40µm	Icing Tunnels	Green	Green	Orange *	Green	Green	Green	Yellow	Yellow	Green	Green / Yellow *	Green / Orange *	Green	Green / Orange *	Green
	Codes	Green	Green	Yellow	Green / Orange **	Green	Orange	Orange	Orange	Green	Green / Yellow **	Green	Orange **	Green	Orange
	Tankers	Orange	Orange	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow
FZRA MVD < 40µm	Icing Tunnels	Yellow	Yellow	Orange *	Yellow	Yellow	Yellow	Yellow	Yellow	Green	Orange	Orange	Orange	Orange	Orange
	Codes	Yellow	Yellow	Orange **	Yellow / Orange **	Yellow	Orange	Orange	Orange	Yellow	Yellow	Green	Orange	Green	Orange
	Tankers	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange
FZRA MVD > 40µm	Icing Tunnels	Orange	Orange	Orange *	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange
	Codes	Yellow	Yellow	Orange **	Yellow / Orange **	Yellow	Orange	Orange	Orange	Yellow	Yellow	Green	Orange	Green	Orange
	Tankers	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange

LEGEND — Updated FEB 2009

- Green: The capability exists today and is suitable to be an element of a means of compliance, or is readily achievable based on current experience
- Yellow: The capability is possible, but has not been demonstrated, or there is limited or no validation.
- Orange: The capability is unknown, or does not currently exist
- * It may be possible to test small scale installation effects, but large scale installations are not currently feasible
- ** Current 2D capabilities exist with large droplet effects, but limitations exist in the use of 3D codes for simulation of Appendix X effects

Table 1 - Assessment of Appendix X Engineering Tool Capabilities

This evaluation of tool capabilities is predominantly based upon NASA LEWICE codes (2D and 3D), the NASA Icing Research Tunnel facilities, and existing icing tanker information such as SAE ARP 5904, *Airborne Icing Tankers*. International icing simulations codes and facilities were considered where information was available. The US Air Force icing tanker that was used for SLD investigations during the 1990's on some commercial airplanes is currently not operational and its capabilities were not assessed.

The main body of the AC states that flight testing in natural Appendix X icing conditions should not be necessary if at least two methods of predicting Appendix X ice accretions are shown to provide similar results. The intent of this guidance is that at least two different methods (for example, icing tunnels and CFD codes) will be used to impart some level of data validation. The intent is not meant to allow as a basis for a finding of compliance the use of two different CFD codes that would give similar results. Table 1 illustrates that for some Appendix X conditions, few of the engineering tools are classified as Green or Yellow for use as a means of compliance. For example, radomes have no engineering tools classified as Green for use as a means of compliance. In other cases, such as areas aft of protected areas, there is only one simulation tool that is classified as Green.

In freezing rain (FZRA), there are very few engineering tools classified as Green, indicating that the primary method for showing compliance available at this time appears to be natural icing flight testing. In some cases, engineering judgment may allow other methods of compliance, even though not validated, when used in a fashion similar to that recommended for freezing drizzle (FZDZ). However, until the engineering tools become more mature, flight tests in natural Appendix X icing conditions will likely be necessary to achieve the confidence necessary for certification of airplanes for unrestricted flight in Appendix X or a portion of Appendix X conditions (i.e., compliance with 25.1420(a)(3) or 25.1420(a)(2)).

For airplanes certificated to detect Appendix X icing conditions and safely exit all icing conditions (i.e., compliance with § 25.1420(a)(1)), it may be acceptable to use one tool alone, even if Yellow or Red, without natural icing flight tests, provided that the one tool is used in a conservative manner. In cases where there are two Green tools available, the applicant should use both tools to verify results, as discussed in the main body of the AC.

Test cases may be reduced through the use of conservative test methods and critical-point analyses. However, validation of the test methods should be accomplished until confidence is provided

2. Capabilities & Limitations of Engineering Tools and SLD Measurement Instrumentation

2.1. Icing Tunnel Appendix X Simulations

Tunnels that have independent pressures at the nozzles may be able to produce the Appendix X bi-modal distributions. A tunnel that uses a single pressure source for spray bars cannot simultaneously produce the large and small droplet distributions defined in Appendix X. However, NASA developed a technique called "sequencing" that alternates large and small droplet sprays to simulate Appendix X.

The following should be considered when icing tunnels are used as an element of the means of compliance:

- Scale effects must be considered relative to tunnel blockage effects for all tests.
- For FZDZ MVD<40µm, the cloud drop distributions are similar in the IRT to existing Appendix C calibrations

- If there are concerns with the bi-modal distribution affecting the performance of ice protection systems, sequencing has been demonstrated in the freezing drizzle regime for an unprotected surface. This technique approximates the droplet distributions found in natural conditions (insert reference # for NASA sequencing paper). This technique results in rougher textures than Appendix C ice shapes.
    - Unprotected shapes are generally picked to be critical from the perspective of producing the largest disruption to the airflow. Consequently, details on the impingement limit characteristics may not be essential. However, sequencing may be necessary if standard sprays[1] do not produce the droplet distribution appropriate for simulation of the conditions desired. For example, in cases where the impingement limit characteristics are important, sequencing may be necessary.
    - In general, sequencing produces rougher textures than a standard spray.
    - Sequencing may not be appropriate for thermal systems since the mass flux of incoming water is not the same for the small and large droplet sprays.
    - If sequencing is used on deicing systems, the ratio of sequencing time to shed cycles should be evaluated to ensure that sequencing does not inappropriately affect the ice shape.

Hybrid airfoil design methods have been used in icing wind tunnels for experimental testing of subscale airfoils with full-scale leading edges to determine leading edge ice shapes for large-chord airfoil sections[2,3]. These techniques have been used successfully for Appendix C icing conditions. Adapting these techniques to icing tests for SLD conditions requires an evaluation of areas of impingement interest and analysis of the flow-field to determine if scale conditions aft of the leading edge can be met regarding compromises in design variables on circulation, velocity distribution and impingement characteristics. Although it is anticipated that this approach would be applicable for SLD conditions, the hybrid airfoil design technique for SLD conditions has not been tested and validated to date.

2.2. Computational Fluid Dynamic Tools

Computational fluid dynamic (CFD) tools are used extensively in certification for Appendix C conditions. CFD tools can provide valuable information on impingement limits, icing limits, ice size, shape, and thickness for Appendix X conditions. Some

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[1] The phrase “standard spray” method refers to using the IRT nozzles in off-design conditions to generate larger drops for SLD conditions.

[2] Saeed, Farooq, Selig, Michael S. and Bragg, Michael B., "Design of Subscale Airfoils with Full-Scale Leading Edges for Ice Accretion Testing," Journal of Aircraft, Vol. 34, No.1, 1997.

[3] Saeed, Farooq, Selig, Michael S., Bragg Michael B., and Addy, Harold E. Jr., "Experimental Validation of the Hybrid Airfoil Design Procedure for Full-Scale Ice Accretion Simulation,” AIAA Paper No. 98-0199, Reno, NV, January 12-15, 1998.

validation of collection efficiency and ice shapes has been accomplished for FZDZ; there have been no validation exercises for FZRA.

CFD tools have been devised to simulate ice accretion for SLD conditions and the behavior of various types of ice protection systems. Aside from the protected surfaces, these CFD tools can account for the possibility of SLD ice impingement beyond the ice protection system limits, as well as for possible water runback. No current CFD method can identify the breakup of water into rivulets, roughness formation, or ice sliding that may occur under these circumstances. As such, analysis of the regions behind ice protection systems requires some combination of CFD results, empirical data and test results (if available), and engineering judgment. This usually consists of determining the extent of possible ice formation using some criteria from the computational analysis, such as ice extent, impingement limits, or some minimum ice thickness level. The resulting ice shape would consist of a simulation of any intercycle or residual ice on the protected region combined with the simulation of the ice formed aft of the protected region. This result is then combined with guidance on ice roughness levels, such as described elsewhere in this document, to produce a rough ice region that can be evaluated in wind tunnel testing or flight tests.

Information can be calculated for drop trajectories for evaluating sensor locations and potential visual cues.

Many non-lifting surfaces require the use of 3D codes. At the current time, many 3D codes do not have large droplet effects (such as splashing and break-up). Even without large droplet effects, 3D codes can offer information on impingement limits. Although 3D codes may have physical models and correlations that can support analysis of large droplet icing, the capabilities to perform 3D SLD CFD have not yet been evaluated. There are codes that may have this potential, but no guidance can be offered at this time regarding their use.

Some codes have limited capabilities with short-chord geometries (e.g., antennas or struts) for Appendix C icing conditions. These limitations are expected to be similar for large drop icing and are typically addressed using empirical methods or icing tunnels. However, for non-lifting surfaces, conservative assessments may be acceptable, such as assuming the full frontal area, a collection efficiency of one, and approximating the shapes appropriate for the temperature (glaze, rime, etc.).

2.3. Icing Tankers

Icing tankers have been used extensively by some manufacturers for Appendix C icing certifications. Icing tankers typically have limited plume size and have been used primarily for localized icing effects, such as ice shedding and assessing the thermal performance of anti-ice systems.

Current tankers do have some limited capabilities to produce freezing drizzle sized drops but cannot produce the distribution effects. Current tankers do not produce freezing rain distributions and the feasibility of producing such conditions is likely limited by drop break-up (due to deceleration effects) and the ability to sub-cool the large drops within a workable flight envelope. Additionally, drop sorting effects are likely due to higher fall rates of large drops within an Appendix X distribution.

2.4. Instrumentation

When making in-situ measurements of Appendix X conditions, it is important to note that technology to make such measurements is rapidly changing. It is essential to consult experts in all phases of the measurement program, including those aware of the latest problems and strengths of each probe. Instrumentation should be used that is suited to the task and it must be mounted in appropriate locations on the aircraft, where the measurements are not affected by the airflow. For certification purposes, the instrumentation must be calibrated. An often-overlooked aspect of a measurement program is the necessity to calibrate the instrumentation at least once during a measurement campaign. Appropriate software and analysis techniques are also essential because complicated algorithms are often necessary in the analysis.

Instruments are required to measure particle concentrations as a function of size over the complete size range, 2 μm to at least 1,500 μm, including cloud droplets and precipitation drops. This may require more than one probe. Liquid water content (LWC) and ice water content (IWC) measurements obtained by integration of 2D images from spectral measurements generally have larger errors than those obtained from probes specifically designed to make such measurements. Consequently, it is recommended that probes designed to measure LWC and, if necessary, IWC directly be used, recognizing that some hot-wire devices detect larger drops (>50μm) with reduced efficiency. Mixed-phase clouds can occur frequently, so it is necessary to be able to discriminate between ice and liquid particles, especially for sizes larger than 50μm, so that ice particles are not incorrectly identified as supercooled large drops. For detect and exit airplanes (§25.1420(a)(1)), measurement of IWC directly may not be necessary; however, for airplanes using natural icing SLD flight tests to certify for a portion of Appendix X (§25.1420(a)(2)) or for unrestricted operations (§25.1420(a)(3)), IWC needs to be determined to assess the SLD conditions.

3. Component Evaluations

3.1. Lifting Surfaces

This paragraph is applicable for anti-icing systems aft of protected area and deicing Systems both on and aft of protected area.

For detect and exit airplanes (§25.1420(a)(1)) in freezing drizzle conditions, icing tunnels alone may be used as a means for developing ice shapes, provided that the model appropriately represents the airfoil beyond the FZDZ icing limit. Roughness may be evaluated in icing tunnel testing and replicated on the ice shapes for flight testing. The standard spray[1] method should be used for anti-icing systems because of the varying mass flux of incoming water associated with sequencing. For deicing systems, it is acceptable to use the standard spray or sequencing technique.

3.2. Radomes

Most radomes are too large to fit into existing icing wind tunnels. Additionally, computational analysis of radomes typically would require 3D codes. Many 3D codes do not have large droplet effects, although some codes may have this potential. (However, all 3D codes do have capabilities with respect to impingement limits.) Consequently, freezing drizzle ice shapes cannot be simulated. Radome ice shapes have been developed in the past using analysis and observed ice shapes from Appendix C flight tests (typically holding ice shapes).

For detect and exit airplanes (§25.1420(a)(1)) in freezing drizzle conditions, one method of compliance would be to modify Appendix C ice shapes to account for the larger impingement regions produced in FZDZ as predicted by the 3D codes. CFD codes maybe used to predict the ice thickness. The ice roughness should be in accordance with paragraph 8 of this Appendix. The radome ice should reflect the total mass associated with the icing exposures for §25.1420(a)(1) airplanes, which are defined in Part II of Appendix X .

3.3. Non-Lifting Surfaces (Antennas, Enhanced Vision Cameras, Struts, Auxiliary Inlets)

For non-lifting surfaces that do not require the use of 3D codes, 2D codes in combination with icing tunnels are available as means of compliance. However, many non-lifting surfaces require the use of 3D codes. At the current time, many 3D codes do not have large droplet effects, although some codes may have this potential.

For detect and exit airplanes (§25.1420(a)(1)), if the non-lifting surface is not critical from an engine ingestion or airframe damage perspective, 3D codes may provide sufficient information for compliance. However, for more critical surfaces, until 3D codes have large droplet effects which have been validated, icing tunnels alone may be used as a means for developing ice shapes.

3.4. Ice Detection Methods

Different types of ice detection require assessment of their capabilities in large droplet conditions, based upon their sensing technology. Magnetostrictive-type ice detectors may experience increased response time in large droplet exposures due to water shedding off of sensing surfaces from splashing and aerodynamic forces, particularly near freezing. This physical behavior may also occur with other types of probes.

While CFD can determine whether the large drops impact the ice detection surface, available CFD codes cannot accurately predict aerodynamic forces that cause drop shedding, or freezing fraction effects which may delay freezing. Therefore, the use of CFD alone for showing that ice detectors function in large drop conditions is not acceptable. When possible, the position installation effects should be evaluated using a combination of codes and icing tunnels. Devices mounted on smaller surfaces could be assessed in an icing tunnel. However, if the device is mounted on the fuselage and tunnel blockage effects would preclude a meaningful icing tunnel test, then CFD codes that adequately predict the shadowing and concentration effects may be used to verify that the equipment is properly located.

3.4.1. Activation of Ice Protection Systems (§25.1419(e))

3.4.1.1. Primary Visual Cues with Advisory Ice Detection Systems

The magnetostrictive type ice detectors can be used as an advisory system since the pre-detection ice accretions are based on the primary means (visual) and are therefore not dependent on the instrument response time. It is acceptable to assume that crew recognition times based upon visual cues will be similar to those for Appendix C conditions defined in AC 25-25.

3.4.1.2. Primary Ice Detection Systems

Due to the lack of engineering tools for FZRA, certification of ice detectors or icing conditions detectors will require validation in natural large droplet conditions, unless ground testing with both FZDZ and FZRA drops representative of Appendix X distributions and temperatures can be substantiated.

3.4.2. Detection for Exit (§25.1420(a)(1))

Certification of visual cues for detect and exit airplanes is discussed in paragraph 4 of this appendix.

Due to the lack of engineering tools for FZRA, certification of ice detection systems for detecting Appendix X conditions will require validation in natural large droplet conditions, unless ground testing with both FZDZ and FZRA drops representative of Appendix X distributions and temperatures can be substantiated.

3.5. Air Data Sensors

3.5.1. Air Data Sensor Position Installation Effects

When possible, the position installation effects should be evaluated using a combination of codes and icing tunnels. Devices mounted on smaller surfaces could be assessed in an icing tunnel. However, if the device is mounted on the fuselage and tunnel blockage effects would preclude a meaningful icing tunnel test, then codes that adequately predict the shadowing and concentration effects are acceptable as the only method for compliance with installation location requirements.

3.5.2. Air Data Sensor Performance Effects

Icing tunnels alone may be used as a means of compliance for determining the performance of air data sensors for compliance with the Appendix X icing requirements of §§25.1323, 25.1325, and 25.13XX. For sensors that have collection efficiencies approaching one, if performance has been shown in FZDZ conditions, then the use of a qualitative analysis based upon water-catch ratios may be used for extrapolation to FZRA conditions.

For air data sensors, test cases may be reduced if the Appendix C or mixed-phase or ice crystal conditions are shown to be more critical than the SLD environment. However, validation of the test methods should be accomplished until confidence is provided. In some cases, such as wing leading-edge-mounted lift transducers, icing tunnel tests may be necessary.

4. Certification for Detect and Exit - §25.1420(a)(1)

4.1. Detect and Exit FZDZ<40μm

FZDZ conditions with an MVD less than 40μm are similar to existing Appendix C distributions with the exception of a small percentage of the mass in drops larger than typical Appendix C. As a result, many of the current Appendix C simulation methods can support compliance. The small percentage of large drops in this distribution can affect the impingement limits and increase the water catch.

If visual cues are used for compliance with §25.1420(a)(1)(i), it may be possible to use codes in combination with icing tunnels to verify the visual cues. Visual cues should not be based on only one engineering method; a second, correlating method should be used.

4.2. Detect and Exit FZDZ>40µm

Where the capabilities of the tools available for FZDZ>40µm are the same as for FZDZ<40µm, the applicant may use similar means of compliance that are adjusted for the FZDZ>40µm icing conditions. The tool capabilities are different for mechanical deicing system protected areas and areas aft of the protected areas.

Other concerns:

- The icing tunnels are classified as Yellow in the FZDZ >40µm regime because use of the tunnels appears feasible but has not been demonstrated. Icing tunnel tests alone are acceptable for the development of ice shapes for deicing system protected areas and areas aft of the mechanically protected areas. Sequencing or standard distributions are acceptable, but the ratio of sequencing time to shed cycles should be examined.

4.3. Detect and Exit Freezing Rain (MVD<40µm & MVD>40µm)

The capabilities of the tools for FZRA are limited. For simulation of accretions on unprotected surfaces and aft of protected areas, CFD codes may be used to determine the difference in impingement region between freezing rain and freezing drizzle. The increase in impingement area can then be simulated using a standard roughness in that region. For areas where a ridge of ice may form, a simulated ridge may be developed using a height developed analytically based upon local water catch. Ridge location could be developed from freezing drizzle icing tunnel tests, and the height would be modified based upon the ratio of local water catch (determined with CFD) between freezing drizzle and freezing rain.

Other concerns:

- Thermal Ice Protection Systems – Analyses to assess the water catch and melting/evaporation rates are acceptable to determine the capabilities of thermal systems in FZRA, provided that the analyses are based upon the validated results of the system capabilities performed for Appendix C and FZDZ. Any additional ice that may form on runback ice shapes in freezing rain should be accounted for by analysis of the runback volume. Potential roughness effects ahead of the runback should be addressed.

- Mechanical Ice Protection Systems – It is acceptable to use the same pre-activation and intercycle and residual ice shapes as for FZDZ. The limits of accretion should be determined using CFD tools.

- Validation of Visual Cues – Use of qualitative analysis that the visual cues used for FZDZ will function in FZRA conditions is acceptable.

5. Certification for a Portion of Appendix X - §25.1420(a)(2)

Current technology does not support distinguishing between FZDZ and FZRA in flight. Due to this concern, airplanes should not be certificated for compliance with §25.1420(a)(2) based upon the boundaries between FZDZ and FZRA. Certification to §25.1420(a)(2) is discussed in the main body of the AC; however, there are concerns about the ability of applicants to define ice shapes which distinguish between the approved portions and the unapproved portions with the current simulation tools. As such, certification for a portion of Appendix X will be challenging and would require close coordination with certifying authorities.

Certification for a portion of Appendix X that considers phase of flight (e.g., takeoff, holding), as discussed in main AC paragraph 8(b), may be feasible. Any method of certification for a portion of Appendix X should be included as part of the certification planning and will require approval from the cognizant certifying authority.

In cases where only one engineering tool or none have been validated as capable of simulating FZDZ or FZRA, the means of compliance should include flight tests in measured Appendix X icing conditions to verify ice accretions.

6. Certification for Unrestricted Operations - §25.1420(a)(3)

The use of the simulation tools as described for detect and exit airplanes may be used for airplanes certificated in accordance with §25.1420(a)(3). However, in cases where only one engineering tool or none have been validated as capable of simulating FZDZ or FZRA, the means of compliance should include flight tests in measured Appendix X icing conditions to verify ice accretions.

7. Compliance with §§25.1323, 25.1325, and 25.773

7.1. Compliance with §§25.1323, 25.1325 and 25.773 for Appendix C and Appendix X Conditions

The exposures to Appendix C and Appendix X conditions should consider holding operations consistent with the applicable Holding Ice definition contained in Part II of those appendices.

7.2. Compliance with §25.1323 for Mixed-Phase and Ice Crystal Conditions

The exposures to mixed-phase and ice crystal conditions should consider the horizontal extents defined in the rule.

8. Standard Roughness Levels for Appendix X Ice Shapes

Ice shapes for Subpart B testing are typically based upon icing tunnel tests or CFD computations or both. Current CFD programs do not provide roughness information. Roughness levels and aft extent of roughness for Appendix X ice shapes should be determined from icing tunnels or tanker testing, if the capabilities exist. However, when the empirical capabilities do not exist, the roughness levels (or equivalents) as defined in Table 2 may be used. Note that roughness levels for Appendix C ice shapes are discussed in AC 25-25.

<table>
<tr><th>Ice Type</th><th>Roughness Height (mm)</th><th>Particle Density</th><th>Notes</th></tr>
<tr><td>FZDZ & FZRA, thin accretions;
thickness < 3mm (0.12 inch)</td><td>1.5 to 2 mm (0.06 to 0.08 inch)
or
16 to 20 grit sandpaper</td><td rowspan="4">Particles density to cover 50% to 70% of total area</td><td>Use to simulate pre-detection, initial accretions, or roughness on computed ice shapes</td></tr>
<tr><td>FZDZ
thickness > 3 mm (0.12 inch)</td><td rowspan="2">3 to 6 mm (0.12 to 0.24 inch)
Mean particle size ~4.5mm</td><td rowspan="3">Intercycle, residual, unprotected surfaces</td></tr>
<tr><td>FZRA
thickness ≥ 3 mm (0.12 inch)
and ≤ 6 mm (0.24 inch)</td></tr>
<tr><td>FZRA
thickness ≥ 6 mm (0.24 inch)</td><td>6 to 8 mm (0.24 to 0.31 inch)
Mean particle size ~7 mm</td></tr>
<tr><td colspan="4">Notes:
1. The simulated roughness elements should approximate roughness elements observed in icing tunnels or natural icing. Smooth and spherical elements should not be used because they may result in non-conservative aerodynamic results.
2. For computed ice shapes, the roughness simulation should be extended aft to the limits of predicted accretion (where the ice accretion thickness is calculated as 0.015").</td></tr>
</table>

Table 2 - Appendix X Standard Roughness